U.S. Army Public Health Command (Provisional)
formerly U.S. Army Center for Health Promotion and Preventive Medicine

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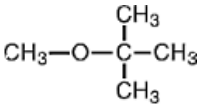
Just the Facts...

MTBE in Drinking Water

Source



Methyl tertiary-butyl ether (MTBE) is a chemical compound manufactured by the chemical reaction of methanol and isobutylene. MTBE is a volatile, flammable, and colorless liquid that dissolves easily in water. In use since 1979 to replace lead in gasoline, MTBE is characterized as an oxygenate or octane enhancer, which is used almost exclusively as an additive in gasoline to improve combustion and reduce emissions. The use of MTBE has increased nationwide to meet the oxygenated fuel requirements in the 1990 Clean Air Act (CAA) amendments, which requires the use of reformulated gasoline (RFG) containing an oxygenated agent to make gasoline burn more efficiently in areas with unhealthy levels of air contamination. MTBE has also been used as a laboratory chemical and in medicine to dissolve gallstones.

Environmental Exposure and Fate

Any place that gasoline is used, transported, or stored is susceptible to MTBE contamination. Contamination of water sources may come from gasoline tanks of recreational water vehicles and automobiles, fuel pipelines, and underground fuel storage tanks (UST). MTBE does not readily adsorb to soil, so that when spilled on the ground, it can easily infiltrate through soil directly into ground water. Additionally, MTBE vapors released into the atmosphere can mix and dissolve in rainfall and carried into water sources. MTBE does not easily biodegrade once it is dissolved in water and is considered to be more persistent in ground water than in surface water. In shallow surface water, volatilization into the air may reduce contamination. The half-life[1] of MTBE in various water sources are:

Flowing surface water: hours to days
Standing water: days to weeks
Ground water: months to years

[1] Half-life: The length of time required for the mass, concentration, or activity of a chemical or physical agent to be reduced by one-half.

Health Effects

Primary routes of exposure are through inhalation and consumption. MTBE can be adsorbed through the skin; however, the process is slow. The majority of MTBE exposure studies have been health effects through inhalation. Limited research to date has been done from ingestion or topical exposure of MTBE in drinking water. Immediate or acute symptoms from consumption may include nausea, dizziness, shortness of breath, and diarrhea. Long term health effects from exposure through inhalation and possibly consumption may include gastrointestinal irritation, liver, and kidney damage. Additionally, cancer and nervous system effects have developed in laboratory rats and mice by exposure through inhalation of MTBE vapors and topical application of high concentrations of MTBE using oil. However, evidence to date is inconclusive on the cancer-causing or nervous system effects of consuming or bathing in MTBE-contaminated water. Furthermore, evidence has also shown that MTBE intake by humans and animals does not stay in the body long, but is metabolized or eliminated from the body within hours.

Current Federal Regulatory Guidance

There is no national, health-based standard for MTBE in drinking water. However, MTBE has been placed on the Contaminant Candidate List (CCL) to determine necessary regulation, and the Environmental Protection Agency (EPA) has initiated several activities, which include regular monitoring and additional research to address health effects of MTBE in drinking water supplies. As an interim measure, the EPA has issued a drinking water advisory based on consumer acceptability (i.e., taste and odor) of 20-40 μg/L. Although, the range of 20-40 μg/L is not regulated by the National Primary Drinking Water Standards (NPDWS), exposure to this range is approximately 20,000-100,000 (or more) times lower than the range of exposure for cancer and non-cancer effects observed in rodents. Therefore, the EPA believes that the concentration range of 20-40 μg/L or lower also provides

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a margin of safety from adverse health effects. To prevent MTBE and other fuel-related contamination events in ground and drinking water sources, additional regulations include the Underground Storage Tank (UST) program established in the 1984 Resource Conservation and Recovery Act (RCRA) amendments to set operating and technical standards for underground fuel storage tanks, including a leak detection and cleanup program. As of 1993, all USTs were required to comply, and any tank installed before December 1988 were required to be upgraded, replaced, or removed. It is estimated that perhaps 85% of all tanks were in compliance December 1998.

Current State Regulatory Guidance

Due to increasing uses and occurrences of MTBE, approximately 30 States have taken the initiative to establish drinking water standards (i.e., primary, secondary, or health advisory) for MTBE concentration levels. The following table is a partial list of State-regulated guidelines:

State-Specific Drinking Water Standards (μg/L)

State	Primary	Secondary	State or other Advisory
California	13	5	20-40
Georgia	--	20-40	
Michigan	240	40	
Maryland	--	--	20
New Mexico	--	100	
New York	50	--	
Texas	--	15	
Washington	--	--	--

To find additional State drinking water standards contact the State water office or local treatment plant. Contact information may also be obtained from http://www.epa.gov/mtbe/contacts.htm.

Impact on DOD

The DOD consumes approximately 80% of all energy used by the Federal government, including approximately 200 million gallons of gasoline and diesel fuels. Any drinking water regulations will impact both drinking water treatment and ground water cleanup activities. DOD installations that reside in the Continental U.S. (CONUS) will also need to adhere to State requirements. Furthermore, the State of California is the first State to take steps to eventually phase-out the use of MTBE and replace it with other alternatives. Other States may eventually follow suit. Finally, if EPA determines that MTBE poses a significant threat to air quality, water quality, or human health, it could take action to restrict or ban the substance without new legislative authority.

Best Available Technology (BAT)

There are a number of effective technologies that can remove MTBE from drinking water. The most common treatment technologies are 1) air stripping and 2) adsorption using granular activated carbon (GAC). Other treatment alternatives using ultraviolet (UV) or ozone may be feasible, but are likely more expensive. Because MTBE is soluble and less dense than water, it can infiltrate into deep underground aquifers, making ground water remediation complicated and expensive. The best approach to treat MTBE contamination in drinking water sources is at the drinking water treatment plant (WTP). MTBE has a turpentine-like taste and odor, so even small amounts of MTBE in water will require WTPs to implement appropriate treatment. Consumers can also purchase commercial home treatment devices, or otherwise called point-of-use/entry (POU/POE) devices. Several of these devices are certified for efficacy by credible non-governmental organizations. Additional information about specific devices may be obtained from their websites.

NSF International
http://www.nsf.org/consumer/drinking_water/

The Water Quality Association
http://www.wqa.org/

Underwriters Laboratories, Inc.
http://www.ul.com/